

IV. *Some Experiments with Ants' Nests.* By HORACE ST. J. K. DONISTHORPE, F.Z.S.

[Read December 1st, 1909.]

A COLONY of ants may be founded in several ways—

(1) The most simple and ordinary method is that in which the queen ant, after her marriage flight, starts the colony herself. She relieves herself of her wings, either by brushing them off with her feet, or, as I have sometimes seen myself, by grasping them with her jaws, and removing them with a jerk. Selecting a suitable spot, she digs a small chamber in the ground or under a stone, and laying her eggs she tends them till the first batch of workers are hatched.

(2) The female, again, may obtain admission into a small queenless colony of a different species, and there bring up her offspring. When the host species has died out, there will remain a pure colony of the queen species. This has been called "Temporary Social Parasitism."

(3) The queen may also enter a small colony of another species, and killing the workers, take possession of the pupae. When these have hatched and have helped her to bring up her own brood, the mixed character of the nest is kept up by raids on the host species, which is commonly known as "slavery" in ants.

(4) A female may obtain admission into the nest of another species, and there permanently reside with her offspring, this has been called "Permanent Social Parasitism."

Now, as is well known, ants, as a rule, strongly object to the intrusion of strange ants, either of their own or of another species. Touch and smell are the two principal senses in ants, and the antennae are the chief organs in which they chiefly reside. Forel says the members of a colony know each other by smell and contact. Wasmann has called their antennae "touching noses," and says they do not know each other personally, but recognise each other by an intelligent "parole," a recognised form of antennae stroke. Miss A. W. Fielde has carried out a

TRANS. ENT. SOC. LOND. 1910.—PART II. (JUNE)

number of experiments to prove that each of the different joints of an ant's antennae has a different function. For example, the 12th or final joint recognises the home or nest odour, the 11th recognises personal relations, the 10th the path or track, etc. The authoress also concludes that the whole nest aura changes every two or three months. Though these experiments were very carefully elaborated, I do not think too much importance should be attached to them; and this, I believe, is the opinion of both Father Wasmann and Prof. Wheeler. The subject is far too difficult and intricate to be settled at once. Herr Bethe wished to prove that it was only by smell that ants knew each other, and he found that when they were washed in alcohol and water, dried, and bathed in a liquor of crushed ants from another nest, they were received by that nest. This, however, is only the case for a short time, the strangers being eventually killed. Also ants returned after similar treatment to their own nest are not recognised for a long time. Lord Avebury has pointed out that ants that had been soaked in water were not at first recognised by their friends.

Any careful experiments with ants' nests are therefore of the greatest value and interest, as a means of helping those who are endeavouring to clear up these difficult problems. I will now give the results of some experiments with ants' nests, which touch on the different points discussed above.

On April 2nd, 1907, I established a nest of *Formica rufa*, from Oxshott, in my study. It contained 12 ♀♀ and many ♂♂, etc. On April 12th I brought up from the same nest at Oxshott, some more ♀♀ and ♂♂. They were at once recognised and received with pleasure, the ♀♀ being cleaned and led into the nest. On April 26th, I brought up a ♀ and some ♂♂ from another nest at Oxshott, far removed from the first nest. These also, to my surprise, were equally well received.

These ants must have sprung from the same stock, since ♀♀ and ♂♂ from Weybridge and Bournemouth were attacked, and dragged about and killed. I have also been in the habit of obtaining ants in the spring from the same nests I took them from the year before and introducing them into my observation nests, and always found them well received and undoubtedly recognised. I extract the

following from one of my note-books—"May 19th, 1907. Took part of a nest of *F. rufa* at Weybridge"; then later on, "April 7th, 1908. Got some more *débris* from the same nest at Weybridge, 4 ♀♀, ♂♂, etc.; ants all well received." This is the *rufa* nest I have still, which is doing very well.

Mr. Keys, of Plymouth, when starting some observation nests of *Formica rufibarbis* v. *fusco-rufibarbis* from Whitsand Bay, told me that he mixed ♀♀ and ♂♂ from different nests in that locality, and that they agreed perfectly well together. These facts look as if the "recognition method" is inherited in a common stock, and also appear to disagree with the theory of the progressive odour of ants.

In the "Ent. Mo. Mag." for April and May 1909, Mr. Crawley publishes some experiments with *Lasius* species, ants which found their colonies in the simple or primitive method. He records cases where queens of *Lasius umbratus* were accepted by colonies of *L. niger*.

On May 17th, 1907, I obtained and fixed up in a large glass bowl, a nest of *Formica sanguinea* from Woking, which contained very few slaves, and all the ♂♂ were of a small type. (The nest contained over 60 specimens of *Lomechusa strumosa*, which may account for the small size of the ♂♂, though no pseudogynes had yet been produced.) Large *sanguinea* ♂♂ taken from a nest at Woking, quite near to this one, were all dragged about and killed when introduced into this observation nest.

In this case workers of the same species from another nest in the same locality were attacked and killed.

On April 17th, 1909, I took a small nest of *Formica rufibarbis* v. *fusco-rufibarbis* at Whitsand Bay. It contained a ♀ and about 25 ♂♂, and I put them into a small plaster nest on April 22nd. No eggs were ever laid by this ♀. On June 1st I removed some of the ♂♂ and introduced them into a small bowl which contained sand and a ♀ of *F. fusca* taken at Bradgate Park on May 3rd, 1909. This queen had laid a few eggs in a small chamber underneath a piece of damp sponge. On June 27th, I introduced the rest of the *rufibarbis* v. *fusco-rufibarbis* ♂♂. The queen was not attacked, and on July 4th all the ♂♂ had collected under the sponge with the queen. On August 3rd I liberated them all at Ryde in the Isle of Wight.

In this experiment a *fusca* ♀ was adopted by workers of a different race from a different locality.

On July 14th Mr. Keys sent me up several different nests of *F. rufibarbis* v. *fusco-rufibarbis* from Whitsand Bay, which contained many pupae. On August 10th I allowed two of these colonies, which I had placed in separate compartments of a combined Fielde and Jannet nest, to mix, by removing the obstruction in the passage between the two compartments. They were all quite friendly, and eventually collected all the pupae that were left (many ♂♂ had hatched from the others) in one side of the nest.

Here two colonies from different nests in the same locality combined at once when allowed to mix with each other.

On May 9th I took 5 ♀♀ and a number of ♂♂ from a nest of *Formica sanguinea* at Woking. These I eventually put into a large bowl with sand, and a damp sponge. The ants burrowed into the sand under the sponge. On July 23rd I introduced many winged ♀♀ and ♂♂, some pupae and a few ♂♂ from a *sanguinea* nest at Bewdley Forest. None of these were attacked! On July 25th the Woking ♀♀ were up under the sponge, and all the ants were together with the pupae.

Here ants of the same species from quite a different locality mixed quite peaceably together. This is very strange; it may be that as the first colony were under the sand, and did not come up till two days after the second lot of ants had been introduced, the latter may have acquired the smell or nest aura. Also the first nest was not very strong as many of the ♂♂ had died. In any case I can only state what actually occurred.

On April 21st I put a number of ♂♂ of *Lasius flavus*, which I had brought up from Whitsand Bay, into a glass bowl with sand. On May 6th I introduced two ♀♀ *flavus* from Bradgate Park, these were accepted by the ♂♂, and on May 8th eggs were laid in a small chamber under a bit of damp sponge, and the ♀♀ were attended by the ♂♂. A ♀ *flavus* from Portland was attacked and killed when introduced. The nest was eventually destroyed by mould.

In this experiment ♀♀ of the same species were accepted by ♂♂ from a different locality in a nest without a ♀.

On June 1st Mr. Forsyth sent me up from Portland a large nest of *Lasius flavus*, which contained 3 ♀♀ many ♂♂, eggs and pupae, and some 50 *Claviger foveolatus*. I kept the main nest in a large glass bowl with sand, and put 2 of the ♀♀ and a dozen ♂♂ and

*Clavigers* into a small plaster nest for observation. From June 1st till the end of August I kept introducing ♂ ♀ from the main nest into the small plaster nest, and they were always recognised and well received. On August 9th I introduced ♀ ♀ of *Solenopsis fugax* taken with *Lasius niger* at Sandown. These were all killed by the *flavus* ♀ ♀.

Here we see that ants from the same nest, separated for some time, were recognised and well received when brought together again. The experiment with *Solenopsis* was perhaps too severe a test, as the little parasitic ants had nowhere to hide in the plaster nest.

I now come to my experiments with nests of *Formica fusca* and *rufibarbis* v. *fusco-rufibarbis* and ♀ ♀ of *Formica sanguinea*. The modern view of the foundation of colonies by the *Formica rufa*, *sanguinea* and *exsecta* group supposes that the ♀ after her marriage flight enters a small nest of *F. fusca*, or one of its races, and takes possession of the pupae, being accepted by the workers, or killing them if they prove to be antagonistic. This opinion is held, I believe, by both Father Wasmann and Prof. Wheeler. It is certainly the case that no one has ever witnessed, either in Europe or America, a ♀ of the *rufa* group founding a colony by herself, as may be seen in *Lasius* and *Myrmica*, etc. I have observed quite small nests of *F. rufa* at Weybridge, which appear to have been quite recently formed, but I believe these to have split off from older nests, of which there are large numbers in the locality. I have also seen individuals of this species at Buddon Wood moving the whole nest to a new situation; the pupae and entire contents of the nest and most of the nest materials being carried bodily away. For fifteen years I have known a very large nest at Weybridge. A few years ago a part of the ants in this nest moved to a spot close at hand. This year the ants in the old portion have moved to another spot near to the first new settlement, the old nest being deserted. Nests may spread in this way, but this has nothing to do with the founding of a colony by a single queen. I have no doubt some of the young queens return to the old nest after their marriage flight, but the problem is to ascertain the fate of those that do not. In order to test this question in the most exhaustive manner, we require a young female just after her marriage flight, and also a small, or impoverished, *fusca* nest. The

latter, as Prof. Wheeler quaintly remarks, are as rare as "hens' teeth" when one starts to look for them. As to the former, I have personally never seen or come across a marriage flight of either *rufa*, *sanguinea*, or *exsecta*. I therefore made up small colonies of *fusca* and *rufibarbis* v. *fusco-rufibarbis* by putting a limited number of ♂♂ and pupae into a combined Fielde and Jannet nest, and introduced ♀♀ of *F. sanguinea*. I used both old deälated, and doubtless impregnated, ♀♀, and young winged virgin ♀♀, taken from *sanguinea* nests. From the latter I removed the wings, as Wheeler has shown that when the wings are removed the ♀ acquires the instincts of an impregnated female.

Before describing my experiments, I must mention that I kept *sanguinea* ♀♀ in bowls of sand for months, alone and together, and they never attempted to lay eggs or start a colony. When, however, a few pupae, of this or another species, were introduced, they sometimes collected them together and sat upon them.

No. 1. A small nest of *F. fusca* ♂♂ and larvae taken at Sherwood Forest on June 13th. On June 24th I introduced a ♀ *sanguinea*, which I had taken from a nest at Aviemore on May 17th. She still retained one wing, which I removed. The *fusca* ♂♂ ran away at first when the ♀ approached them, but later attacked her. The ♀ bit at the *fuscas* when attacked. In the evening they were still fighting. The ♀ did not pay any attention to the larvae and did not try to conciliate the ♂♂, but ran away from them. By June 25th 5 ♂♂ had been killed by the ♀, and the rest were in the passage between the two compartments with the larvae. June 27th, ♀ still attacked a little, several more ♂♂ killed. I introduced some large *niger* pupae, which the *fuscas* collected with their larvae. On June 28th, the ♀ appeared to be accepted by the ♂♂, as they were all sitting together, and several ♂♂ were cleaning the ♀. On July 2nd, the ♀ was dead, no doubt from injuries received in the previous encounters.

In this experiment the ♀ was finally accepted by the ♂♂, although she died from injuries received.

No. 2. July 4th, introduced deälated ♀ *sanguinea*, taken at Woking, May 5th, into small *fusca* nest with pupae. The ♀ approached the pupae and tapped them with her antennae, evidently much interested in them. The ♂♂ removed them, but the ♀

was little attacked and repulsed ♀ ♀. I gave them a little honey, and the ♀ and ♀ ♀ fed side by side. July 5th, the ♀ had collected all the pupae into a corner and sat on them, 2 ♀ ♀ were with her, but several others were dead and injured. July 6th, ♀ on guard over all the pupae in one corner, all ♀ ♀ killed but 3. These try to remove pupae one by one. ♀ brings them back again. I introduced some pupae and larvae from a *fusca* nest from Weybridge. ♀ collected them all together into her corner. July 15th, only 2 ♀ ♀ left, quite friendly with ♀, all sitting together on the pupae. July 18th, all well and friendly together.

This experiment was quite successful, the ♀ took possession of the pupae, killed ♀ ♀ when attacked, and eventually became friendly with the remaining two.

No. 3. On July 12th Mr. Hamm sent me up a small *fusca* nest from Shotover. It contained many pupae, ♀ ♀ and 2 *Atemeles* larvae. I placed them all in a combined Fielde and Jannet nest. July 15th, introduced a deälated *sanguinea* ♀ taken at Woking, May 9th. The ♀ was at once fiercely attacked by the ♀ ♀. She was not very aggressive herself when attacked. In the afternoon she was still being attacked, and held by her legs and antennae by many ♀ ♀. July 16th, ♀ no longer attacked, but has lost an antennae. July 17th, ♀ not attacked, in corner by herself. July 18th, ♀ dead.

In this experiment the ♀ took no notice of the pupae, did not resist much when attacked, and finally died from injuries received. One difficulty in these experiments is that it is not possible to provide a means for the ♀ to escape, if she wished to do so, as she could in nature.

No. 4. July 15th, Mr. Keys sent me up several *F. rufibarbis* v. *fusco-rufibarbis* nests from Whitsand Bay. July 17th, introduced deälated *sanguinea* ♀ taken at Aviemore, May 17th. She approached the pupae, when she was fiercely attacked by the workers, and killed the same day.

No. 5. Another *rufibarbis* v. *fusco-rufibarbis* nest. July 17th, introduced deälated *sanguinea* ♀, also from Aviemore. Immediately attacked by 2 ♀ ♀, with which she fiercely grappled and killed both during the day. July 18th, ♀ dead!

Nos. 6 and 7. July 23rd, introduced virgin *sanguinea* ♀ ♀ (having removed their wings), taken at Bewdley, July 21st, into

two *rufibarbis* v. *fusco-rufibarbis* nests. Both ♀ ♀ killed the same day.

No. 8. July 23rd, introduced virgin *sanguinea* ♀, from Bewdley, having removed her wings, into a *fusca* nest. ♀ at once attacked and killed same day.

No. 9. July 23rd, removed the wings from a virgin ♀ *sanguinea*, taken at Bewdley, and placed her in a tin with some pupae. July 24th, introduced this ♀ into the *fusca* nest from Shotover. Attacked by 2 ♂ ♂, which she killed. Later ♀ captured some of the pupae and sat on them in a corner. The ♂ ♂ collected the rest of the pupae into another corner. Later ♀ injured another ♂, and killed one that fastened on to her leg, and captured more of the pupae. July 25th, all ♂ ♂ killed but one, ♀ sitting on all the pupae in one corner. July 26th, ♀ carrying pupae about and arranging in corner, where she sat upon them. I introduced a few *rufibarbis* v. *fusco-rufibarbis* ♂ ♂ into the nest. When these approached the pupae the ♀ sprang forward and seized them and shook them as a terrier shakes a rat, and killed them all.

This experiment was quite successful. The ♀ killed all the ♂ ♂, and took possession of all the pupae.

No. 10. July 25th, introduced virgin ♀ *sanguinea*, from Bewdley, into a *rufibarbis* v. *fusco-rufibarbis* nest. On July 23rd I had removed the wings and placed her in a small dark tin with a few pupae. ♀ was attacked and killed in two hours.

No. 11. July 25th, introduced a virgin ♀ *sanguinea*, from Bewdley, which had been treated like the last one, into a *rufibarbis* v. *fusco-rufibarbis* nest. ♀ attacked and killed several ♂ ♂. July 26th, ♀ dead.

No. 12. July 28th, introduced virgin ♀ *sanguinea*, from Bewdley, after same treatment, into a *rufibarbis* v. *fusco-rufibarbis* nest. Much attacked by ♂ ♂. July 29th, ♀ dead.

No. 13. July 28th, separated 6 *rufibarbis* v. *fusco-rufibarbis* ♂ ♂ with pupae into one compartment of nest. August 9th, introduced virgin ♀ *sanguinea*, from Bewdley, which had shed her wings. Immediately attacked by 2 of the ♂ ♂, and killed the same morning.

It will thus be seen that in no single case was a ♀ *sanguinea* accepted by *rufibarbis* v. *fusco-rufibarbis* ♂ ♂, the ♀ always being killed, and generally the same day she was introduced. This ant is a much bolder race than pure *fusca*, the latter being a timid and cowardly species. In

nature when a *fusca* nest is disturbed, the ants immediately scatter and run away, all disappearing in a very short time. This is by no means the case with *rufibarbis* v. *fusco-rufibarbis*.

In future for further experiments I shall only use *fusca* ♂♂, and shall next try ♀♀ of *F. rufa*.

The two successful experiments with *fusca* show that it is quite possible for a *sanguinea* ♀ to start a colony in this way, but it seems rather a precarious method to depend upon.